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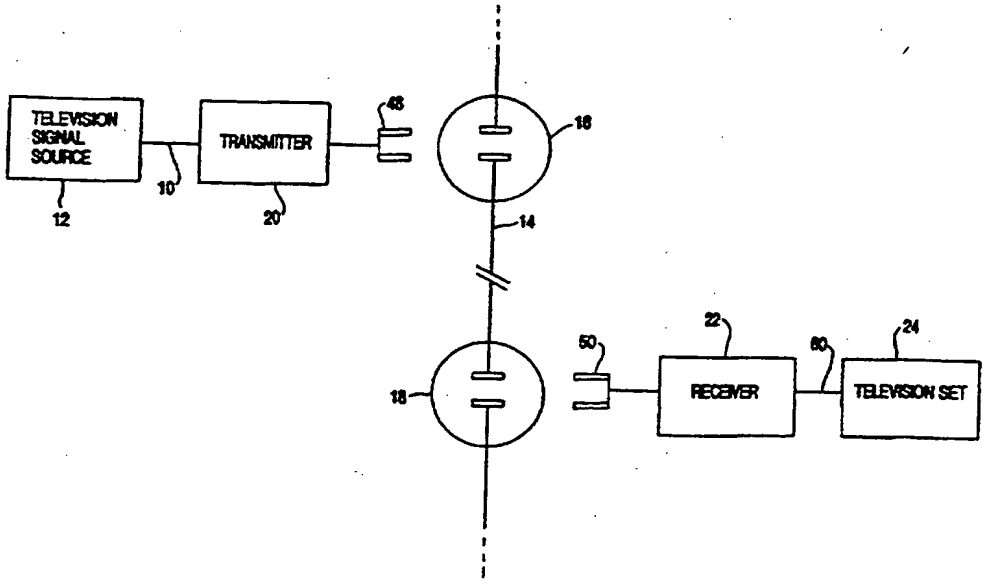

(57) Abstract

A power line communications system in which information signals are frequency multiplied in a transmitter unit, so that the critical information portions of the information signals are frequency shifted from a notch in the frequency response characteristic between an outlet in the power line communications system to which the transmitter unit is connected and an outlet in the power line communications system to which a receiver unit is connected, whereby the critical information portions of the information signals are not lost in the notch.

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POWER LINE COMMUNICATIONS SYSTEM

TECHNICAL FIELD

The present invention relates, in general, to the communication of information and, in particular, to the transmission and reception of information signals along the power lines in a building.

BACKGROUND OF THE INVENTION

The lines by which power is distributed in a building can be and are used for the transmission of information signals between rooms within a building. Power lines can exhibit severe amplitude variations in the frequency bands used for power line communication. These amplitude variations are due to a number of factors such as unterminated (i.e. open) outlets, the number and type of units (e.g. lamps, appliances, heaters, etc.) which are plugged into the outlets, the cycling of certain units (e.g. heaters) which are plugged into the outlets, and the lengths of the power lines between the outlets.

When the power line communications system is used to transmit television signals, most of the amplitude variations are "dips" in the order of 10dB to 20dB which are spread over a few or more hundreds of kilohertz. Such "dips" can be tolerated in that the signals can be amplified to the extent necessary, or the subjective effects of these dips on the picture quality is acceptable..

However, at some frequencies, the attenuation can be in the order of 50dB or 60dB or even 70dB and spread over less than 100 Khz. Such a sharp attenuation is called a "notch" or "suck-out." If critical signal information (e.g. the most important part for picture information of a television signal) happens to fall at a notch, it is highly attenuated and very difficult, if not impossible, to amplify to provide expected system performance.

For television signals, critical information is around the picture carrier. If such a notch is near the picture carrier, the circuitry by which information signal input of the television set is connected to the power line might not be able to provide the required gain (i.e. Automatic Gain Control), while maintaining the desired signal-to-noise (S/N) ratio in its output. It is possible that the circuitry in the television set connected to the

power line might not be able to derive synchronizing information for satisfactory operation.

SUMMARY OF THE INVENTION

The present invention is directed to alleviating the effects of severe attenuation of signals carrying critical information in a power line communications system. A power line communications system, constructed in accordance with the present invention, includes first signal conducting means for supplying information signals over a first band of frequencies from an information signal source, a power line and a plurality of outlets individually connected to the power line, including a first outlet at which the information signals are transmitted and a second outlet at which the information signals are received. The information signals are conducted to the power line by a transmitter unit and are conducted from the power line by a receiver unit. The transmitter unit includes first oscillator means for supplying a first carrier signal, control means for controlling the oscillator means to set the first carrier signal at a first predetermined frequency dependent upon the frequency band of a notch in the frequency response characteristic of a first of the outlets to which the transmitter unit is intended to be connected, and first multiplier means for frequency multiplying the first carrier signal and the information signals to frequency shift the information signals to a second band of frequencies. The transmitter unit also includes second signal conducting means for conducting the information signals after frequency shifting by the first multiplier means to a first of the outlets for transmission of the information signals along the power line to a second of the outlets. A power line communications system, constructed in accordance with present invention, also includes a receiver unit which includes third signal conducting means for conducting the information signals from the second outlet, second oscillator means for supplying a second carrier signal having a second predetermined frequency, and second multiplier means for frequency multiplying the second carrier signal and the information signals conducted by the second conducting means to frequency shift the information signals conducted by the second signal conducting means to a band of frequencies at least approximately the same as the first band of frequencies. The receiver unit also includes fourth signal conducting means for conducting the information signals after frequency shifting by the second multiplier means to a utilization unit.

While the present invention will be described in connection with the transmission and reception of television signals, a power line communications system, constructed in accordance with the present invention, has broader application and can be used to transmit and receive other types of information signals (e.g. telephones, computers, etc.).

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 shows a frequency response characteristic at an outlet of a power line communication system having a notch and modulated television signals transmitted along a power line to which the outlet is connected.

Figure 2 is a block diagram of a power line communications system constructed in accordance with the present invention in which the effect of the notch in the frequency response characteristic of Figure 1 is alleviated.

Figure 3 is a block diagram of the transmitter unit portion of the Figure 2 power line communications system of Figure 2.

Figure 4 is a block diagram of the receiver unit portion of the Figure 2 power line communications system of Figure 2.

Figure 5 is a perspective view of the housing which contains either the Figure 3 transmitter unit or the Figure 4 receiver unit as the housing is being plugged into an outlet.

DETAILED DESCRIPTION OF THE INVENTION

As indicated above, a frequency response characteristic, such as the one illustrated in Figure 1, for an outlet in a power line communications system can result in the loss of the most important part of the information signal transmitted along the system and intended for reception by a utilization unit. The information signals received by the utilization unit are affected by the original transmitted signal and the characteristics of the power line communications system existing between a first outlet at which the information signals are transmitted along the power line and a second outlet at which the information signals are received. If the information signal is, for example, a television signals and the picture information portion centered at **P** of the television signal happens to fall at a **NOTCH** in the frequency response characteristic, the picture information portion of the television signal is highly attenuated and it is very difficult, if not

impossible, to appropriately amplify the picture information portion of the television signal in the circuitry by which the utilization unit is connected to the power line, while maintaining the desired signal-to-noise (S/N) ratio and provide expected system performance. It is possible that the circuitry in a television set connected to the power line, might not be able to derive synchronizing information for satisfactory operation.

Referring to Figure 2, a power line communications system, constructed in accordance with the present invention, includes first signal conducting means, represented by a line **10**, for supplying information signals over a first band of frequencies from an information signal source, such as a television signal source **12** by which cable television signals are delivered to a building.

This power line communications system also includes a power line **14** and a plurality of outlets **16** and **18** individually connected to power line **10**. The information signals are transmitted along the power from outlet **16** and are received at outlet **18**. These outlets may be connected directly by power line wires or may have circuit breakers or fuses in their path and may be on different phases of the power line.

As is well known, the reception and processing of television signals from a cable television connection box or a VCR requires selecting between channel 3 or channel 4 depending upon which of the two is not an active channel for the particular location. For a channel 3 setting of the power line communications system, the information signals supplied from cable television connection box **18** are, ideally, over a band from 60 Mhz to 66 Mhz. For a channel 4 setting of the power line communications system, the information signals supplied from cable television connection box **18** are, ideally, over a band from 66 Mhz to 72 Mhz.

The Figure 2 power line communications system also includes a transmitter unit **20** and a receiver unit **22**. Transmitter unit **20** receives the information signals and is adapted for connection to power line **14** to conduct the information signals to the power line. Receiver **22** also is adapted for connection to power line **14** and conducts the information signals to a utilization unit, such as a television set **24**.

Referring to Figure 3, transmitter unit **20** includes first local oscillator means **26** for supplying a first carrier signal and control means **28** for controlling first local oscillator means **26** to set the first carrier signal at a first predetermined frequency dependent upon the frequency band of a notch in the frequency response characteristic

between a first of the outlets, namely outlet **16** to which transmitter unit **20** is intended to be connected, and a second of the outlets, namely outlet **18** to which receiver unit **22** is intended to be connected. Control means **28** can be in the form of a capacitor/switching network such as the one shown in Figure 3. For the transmission and reception of television signals, a first switch **30** and a first capacitor **32** serve to select between channel 3 or channel 4 operation. For a channel 3 setting of the power line communications system, with switch **30** closed and capacitor **32** placed in parallel with a second capacitor **34**, the first carrier signal supplied by first local oscillator means **26** can be 83 Mhz. For a channel 4 setting of the power line communications system, with switch **30** open and capacitor **32** out of the network, the first carrier signal supplied by first local oscillator means can be 89 Mhz. A second switch **36** and a third capacitor **38** serve to alleviate, as will be explained below, the effects of a notch in the frequency characteristic between outlet **16** to which transmitter unit **20** is adapted for connection and outlet **18** to which receiver unit 22 is adapted for connection.

Preferably, transmitter unit **20** includes first amplifier and shaper means **40** for amplifying and shaping the information signals supplied by television signal source **12**. Signals outside the range of frequencies of the information signals (e.g. 60 Mhz to 72 Mhz for television signals) are attenuated by amplifier and shaper means **40**.

Transmitter unit **20** also includes first multiplier means **42** for frequency multiplying the first carrier signal supplied by first local oscillator means **26** and the information signals (e.g. either in the channel 3 band or the channel 4 band for television signals) to frequency shift the information signals to a second band of frequencies selected for power line transmission. This is shown in Figure 1 by the 6 Mhz band of the information signals extending between, for example, 17 Mhz and 23 Mhz. The amount of frequency shifting of the information signals is selected so that the frequencies of the information signals are below the 40 Mhz upper limit of operation of power line communication systems set by the government.

For the conditions illustrated by the solid line curves of the INFORMATION SIGNALS and the FREQUENCY RESPONSE CHARACTERISTIC in Figure 1, picture information portion **P** of the television signal, extending over a band of approximately 500 KHZ, falls at a **NOTCH** in the FREQUENCY RESPONSE CHARACTERISTIC which extends below an acceptable level illustrated by the dotted line. Those portions of the television signal, specifically the picture information portion

P, falling within the band defined by where the dotted line crosses the FREQUENCY RESPONSE CHARACTERISTIC are likely to be lost due to severe attenuation.

To alleviate this problem, switch **36** in Figure 3 is closed and capacitor **38** is placed in parallel with capacitor **34**. This changes the frequency of the first carrier signal supplied by first local oscillator means **26** a few hundreds of kilohertz, for example 300 KHz, to either 83.3 Mhz or 82.7 MHz for a channel 3 setting of switch **30** or 89.3 Mhz or 88.7 MHz for a channel 4 setting of switch **30**. As indicated by the dashed line curves **L-L** and **H-H** in Figure 1, this results in a different frequency shift of the television signal supplied to first multiplier means **42**. Curve **L-L** corresponds to the "low" product of multiplication by first multiplier means **42** and extends between approximately 16.70 Mhz and approximately 22.70 Mhz with P_L, corresponding to the picture information portion **P** of the television signal, above where the dotted line crosses the FREQUENCY RESPONSE CHARACTERISTIC. Curve **H-H** corresponds to the "high" product of multiplication by first multiplier means **42** and extends between approximately 17.20 Mhz and approximately 23.20 Mhz with P_H, corresponding to the picture information portion **P** of the television signal, above where the dotted line crosses the FREQUENCY RESPONSE CHARACTERISTIC. One or the other of the products of the multiplication by multiplier means **42** can be used for the particular power line communications system.

Preferably, transmitter unit **20** includes second amplifier and shaper means **44** for amplifying and shaping the information signals after frequency shifting of the information signals by first multiplier means **42** and first coupler means **46** which provide filtering, isolation and impedance matching.

Transmitter unit **20** also includes second signal conducting means, in the form of a plug **48**, for conducting to outlet **16** the information signals coupled to plug **48** after frequency shifting by first multiplier means **42** and amplifying and shaping of the information signals by first amplifier and shaper means **44**. The information signals conducted to outlet **16** are transmitted along power line **14** to outlet **18**.

Referring to Figure 4, receiver unit **22** includes third signal conducting means, in the form of a plug **50**, for conducting the information signals from outlet **18**. Preferably, receiver unit **22** includes second coupler means **52** which provide isolation, impedance matching, and filtering.

Receiver unit **22** also includes second local oscillator means **54** for supplying a second carrier signal having a second predetermined frequency and second multiplier means **56** for frequency multiplying the second carrier signal and the information signals conducted by plug **50** to frequency shift the information signals conducted by plug **50** to a band of frequencies at least approximately the same as the first band of frequencies. With the utilization unit (e.g. a television set) arranged to receive information signals over a specific band of frequencies (e.g. 60 Mhz to 66 Mhz for channel 3 or 66 Mhz to 72 Mhz for channel 4), the information signals must be returned, from the frequency band over which the information signals are transmitted and received by the power line communications system, to at least approximately the frequency band at which they can be used by the utilization equipment. Second local oscillator means **54** is arranged to provide a second carrier signal having the requisite frequency such that, when the second carrier signal is multiplied with the information signals by second multiplier means **56**, the information signals are frequency shifted to the requisite band of frequencies. For a television signal, second local oscillator means **54** is set to supply either one of two carrier signals corresponding to either channel 3 operation or channel 4 operation. To the extent that the frequency shifting of the information signals in the transmitter unit **20** has been influenced by switch **36** being closed to alleviate the effects of a **NOTCH** in the frequency response characteristic, the second band of frequencies of the output of second multiplier means **56** will be only approximately the same as the first band of frequencies of the information signals supplied to transmitter unit **20**. However, television set **24** can accommodate television signals having portions outside the prescribed 6 Mhz band for a particular channel.

Preferably, receiver unit **22** includes second amplifier and shaper means **58** for amplifying and shaping the information signals after frequency shifting of the information signals by second multiplier means **56**.

Receiver unit **22** also includes fourth signal conducting means, represented by a line **60**, for conducting to a utilization unit the information signals after frequency shifting by second multiplier means **56** and amplifying and shaping of the information signals by third amplifier and shaper means **58**.

The components of transmitter unit **20**, namely first local oscillator means **26**, control means **28**, first amplifier and shaper means **40**, first multiplier means **42**, second amplifier and shaper means **44**, and first coupler means **46** can be arranged in a

housing **62**, such as the one shown in Figure 5. Plug **48**, by which transmitter unit **22** is connected to outlet **16**, and connector **10**, by which information signals from an information signal source are supplied to the transmitter unit, are fixed to and extend from housing **62**. The components of receiver unit **22** can be arranged in a similar housing with plug **50** and connector **60** fixed to and extending from the housing.

As indicated above, the present invention has application for communication of information signals other than television. For example, a power line communications system, constructed in accordance with the present invention, can be used to transmit and receive telephone signals. For telephone signals, the entire audio signal can get lost in a notch because the audio frequency band is relatively narrow.

Because telephony involves two-way communication, both the location at which the telephone signal enters the power line and the location of an extension have a transmitter/receiver unit which is a combination of the transmitter unit of Figure 3 and the receiver unit of Figure 4. If the notch switch in the transmitter/receiver unit at the location at which the telephone signal enters the building is closed, the notch switch in the transmitter/receiver unit at the location of an extension also must be closed. Typical carrier frequencies for the local oscillators are 5.5 Mhz and 6.5 Mhz, one for each direction of transmission.

While in the foregoing there have been described preferred embodiments of the present invention, it should be understood by those skilled in the art that various modifications and changes can be made without departing from the true spirit and scope of the present invention.

What is Claimed:

1. A power line communications system comprising:

first signal conducting means for supplying information signals over a first band of frequencies from an information signal source;

a power line;

a plurality of outlets individually connected to said power line, including a first outlet at which said information signals are transmitted and a second outlet at which said information signals are received;

a transmitter unit connected to said first outlet and including:

(a) first oscillator means for supplying a first carrier signal,

(b) control means for controlling said oscillator means to set said first carrier signal at a first predetermined frequency dependent upon the frequency band of a notch in the frequency response characteristic between said first and said second outlets,

(c) first multiplier means for frequency multiplying said first carrier signal and said information signals to frequency shift said information signals to a second band of frequencies, and

(d) second signal conducting means for conducting said information signals after frequency shifting by said first multiplier means to said first outlet for transmission of said information signals along said power line to said second outlet; and

a receiver unit connected to said second outlet and including:

(a) third signal conducting means for conducting said information signals from said second outlet,

(b) second oscillator means for supplying a second carrier signal having a second predetermined frequency,

(c) second multiplier means for frequency multiplying said second carrier signal and said information signals conducted by said second conducting means to frequency shift said information signals conducted by

said second signal conducting to a band of frequencies at least approximately the same as said first band of frequencies, and

(d) fourth signal conducting means for conducting said information signals after frequency shifting by said second multiplier means to a utilization unit.

2. A power line communications system according to claim 1 wherein:

(1) said transmitter unit further includes:

(a) first amplifier and shaper means for amplifying and shaping said information signals supplied by said first signal conducting means from the information signal source,

(b) second amplifier and shaper means for amplifying and shaping said information signals after frequency shifting of said information signals by said first multiplier means, and

(b) first coupler means for coupling said information signals to said second signal conducting means after frequency shifting of said information signals by said first multiplier means and amplifying and shaping of said information signals by said second amplifier and shaper means; and

(2) said receiver unit further includes:

(a) second coupler means for coupling said information signals conducted by said second conducting means to said second multiplier means, and

(b) third amplifier and shaper means for amplifying and shaping said information signals after frequency shifting of said information signals by said second multiplier means.

3. A power line communications system according to claim 2 wherein said information signals are television signals and the utilization unit is a television set.

4. A power line communications system according to claim 3 wherein said control means control said first oscillator means to selectively set said first carrier

signal at said first predetermined frequency dependent upon channel 3 or channel 4 operation of the television set.

5. A power line communications system according to claim 2 wherein said control means include a switch for controlling said first oscillator means to selectively set said first carrier signal at said first predetermined frequency if said frequency response characteristic between said first outlet and said second outlet has a notch.

6. A power line communications system according to claim 3 wherein said control means include:

(1) a first switch for controlling said first oscillator means to selectively set said first carrier signal at said first predetermined frequency dependent upon channel 3 or channel 4 operation of the television set, and

(2) a second switch for controlling said first oscillator means to selectively set said first carrier signal at said first predetermined frequency if said frequency response characteristic between said first outlet and said second outlet has a notch.

7. A transmitter unit for a power line communications system comprising:

signal conducting means for supplying information signals over a first band of frequencies from an information signal source;

local oscillator means for supplying a carrier signal;

control means for controlling said local oscillator means to set said carrier signal at a predetermined frequency dependent upon the frequency band of a notch in the frequency response characteristic between a first outlet in the power line communications system to which the transmitter unit is adapted for connection and a second outlet in the power line communications system to which a transmitter unit is adapted for connection;

multiplier means for frequency multiplying said carrier signal and said information signals to frequency shift said information signals to a second band of frequencies; and

signal conducting means for conducting said information signals after frequency shifting by said multiplier means to the first outlet in the power line

communications system for transmission of said information signals along a power line in the power line communications system to the second outlet in the power line communications system.

8. A transmitter unit for a power line communications system according to claim 7 further including:

(1) first amplifier and shaper means for amplifying and shaping said information signals supplied by said signal conducting means from the information signal source,

(2) second amplifier and shaper means for amplifying and shaping said information signals after frequency shifting of said information signals by said multiplier means; and

(3) coupler means for coupling said information signals to said signal conducting means conducting by which said information signals are conducted to the first outlet in the power line communications system after frequency shifting of said information signals by said multiplier means and amplifying and shaping of said information signals by said amplifier and shaper means.

9. A transmitter unit for a power line communications system according to claim 8 wherein said information signals are television signals.

10. A transmitter unit for a power line communications system according to claim 9 wherein said control means control said local oscillator means to selectively set said carrier signal at said predetermined frequency dependent upon channel 3 or channel 4 operation.

11. A transmitter unit for a power line communications system according to claim 8 wherein said control means include a switch for controlling said local oscillator means to selectively set said carrier signal at said predetermined frequency if said frequency response characteristic between the first outlet in the power line communications system to which the transmitter unit is adapted for connection and the second outlet in the power line communications system to which a transmitter unit is adapted for connection of said first outlet has a notch.

12. A transmitter unit for a power line communications system according to claim 9 wherein said control means include:

(1) a first switch for controlling said local oscillator means to selectively set said carrier signal at said predetermined frequency dependent upon channel 3 or channel 4 operation, and

(2) a second switch for controlling said local oscillator means to selectively set said carrier signal at said predetermined frequency if said frequency response characteristic between the first outlet in the power line communications system to which the transmitter unit is adapted for connection and the second outlet in the power line communications system to which a transmitter unit is adapted for connection of said first outlet has a notch.

13. A receiver unit for a power line communications system comprising:

signal conducting means for conducting information signals over a first band of frequencies from an outlet in the power line communications system;

oscillator means for supplying a carrier signal having a predetermined frequency;

multiplier means for frequency multiplying said carrier signal and said information signals to frequency shift said information signals to a second band of frequencies;

amplifier and shaper means for amplifying and shaping said information signals after frequency shifting of said information signals by said multiplier means; and

signal conducting means for conducting said information signals after frequency shifting by said multiplier means and amplifying and shaping of said information signals by said amplifier and shaper means to a utilization unit.

14. A receiver unit for a power line communications system according to claim 13 further including:

(a) coupler means for coupling said information signals conducted from the outlet in the power line communications system to said multiplier means, and

(b) amplifier and shaper means for amplifying and shaping said information signals after frequency shifting of said information signals by said multiplier means.

15. A receiver unit for a power line communications system according to claim 14 wherein said information signals are television signals.

AMENDED CLAIMS

[received by the International Bureau on 6 May 1997 (06.05.97); new claims 16 and 17 added; remaining claims unchanged (2 pages)]

(b) amplifier and shaper means for amplifying and shaping said information signals after frequency shifting of said information signals by said multiplier means.

15. A receiver unit for a power line communications system according to claim 14 wherein said information signals are television signals.

16. (Newly Added) A method of eliminating the effect of a notch in the frequency response characteristic between first and second outlets in a power line communications system comprising the steps of:

supplying information signals over a first band of frequencies from an information signal source;

supplying a first carrier signal;

controlling the frequency of said first carrier signal to set the frequency of said first carrier signal at a first predetermined frequency dependent upon a frequency band of a notch in a frequency response characteristic between first and second outlets connected to a power line;

multiplying said information signals by said first carrier signal after the frequency of said first carrier signal has been set to shift the frequency of said information signals to a second band of frequencies spaced from the frequency band of a notch in the frequency response characteristic between said first and second outlets connected to a power line;

conducting said information signals after the frequency of said information signals has been shifted to said first outlet for transmission of said information signals along a power line to said second outlet;

conducting said information signals from said second outlet;

supplying a second carrier signal having a second predetermined frequency;

multiplying said information signals conducted from said second outlet by said second carrier signal to shift the frequency of said information signals conducted from said second outlet to a band of frequencies at least approximately the same as said first band of frequencies; and

conducting said information signals conducted from said second outlet after the frequency of said information signals conducted from said second outlet has been shifted to a utilization unit.

17. (Newly Added) A method according to claim 16 wherein:

(a) said information signal source is a television signal source,

(b) said utilization unit is a television set, and

(c) the step of controlling the frequency of said first carrier includes the steps of:

(1) controlling the frequency of said first carrier signal to selectively set said first carrier signal at said first predetermined frequency dependent upon channel 3 or channel 4 operation of the television set, and

(2) controlling the frequency of said first carrier signal to selectively set said first carrier signal at said first predetermined frequency dependent upon said frequency response characteristic between said first outlet and said second outlet having a notch.

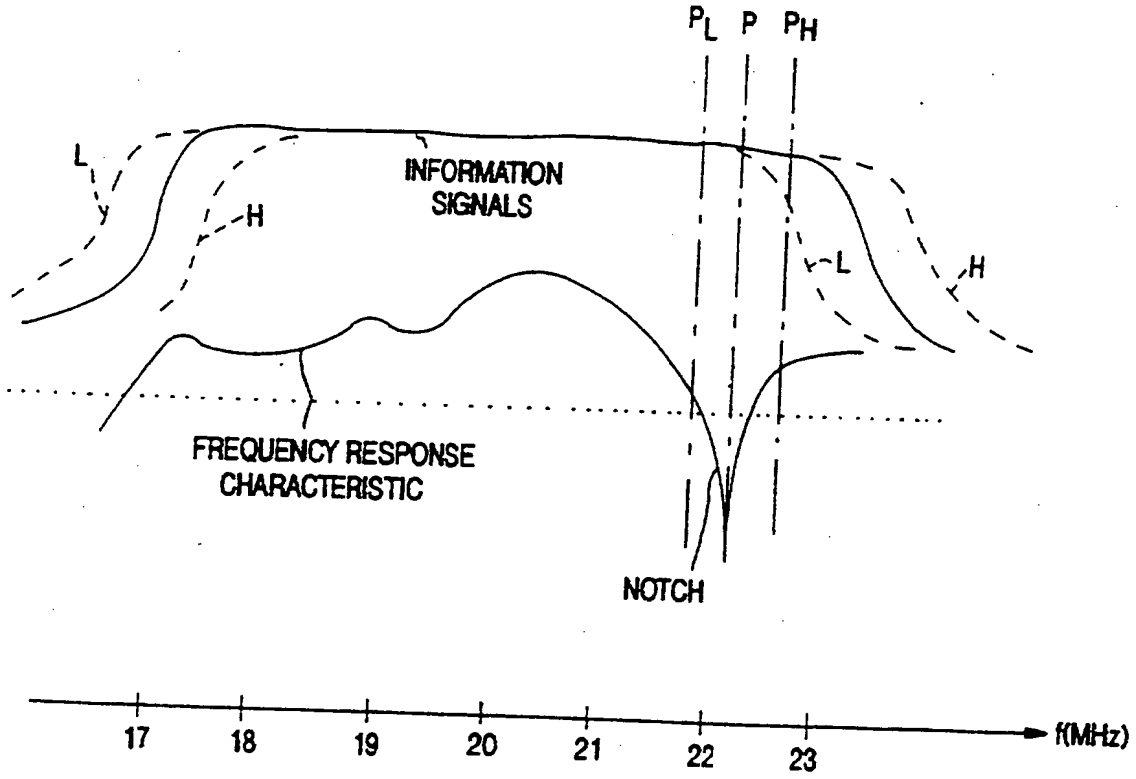

FIG. 1

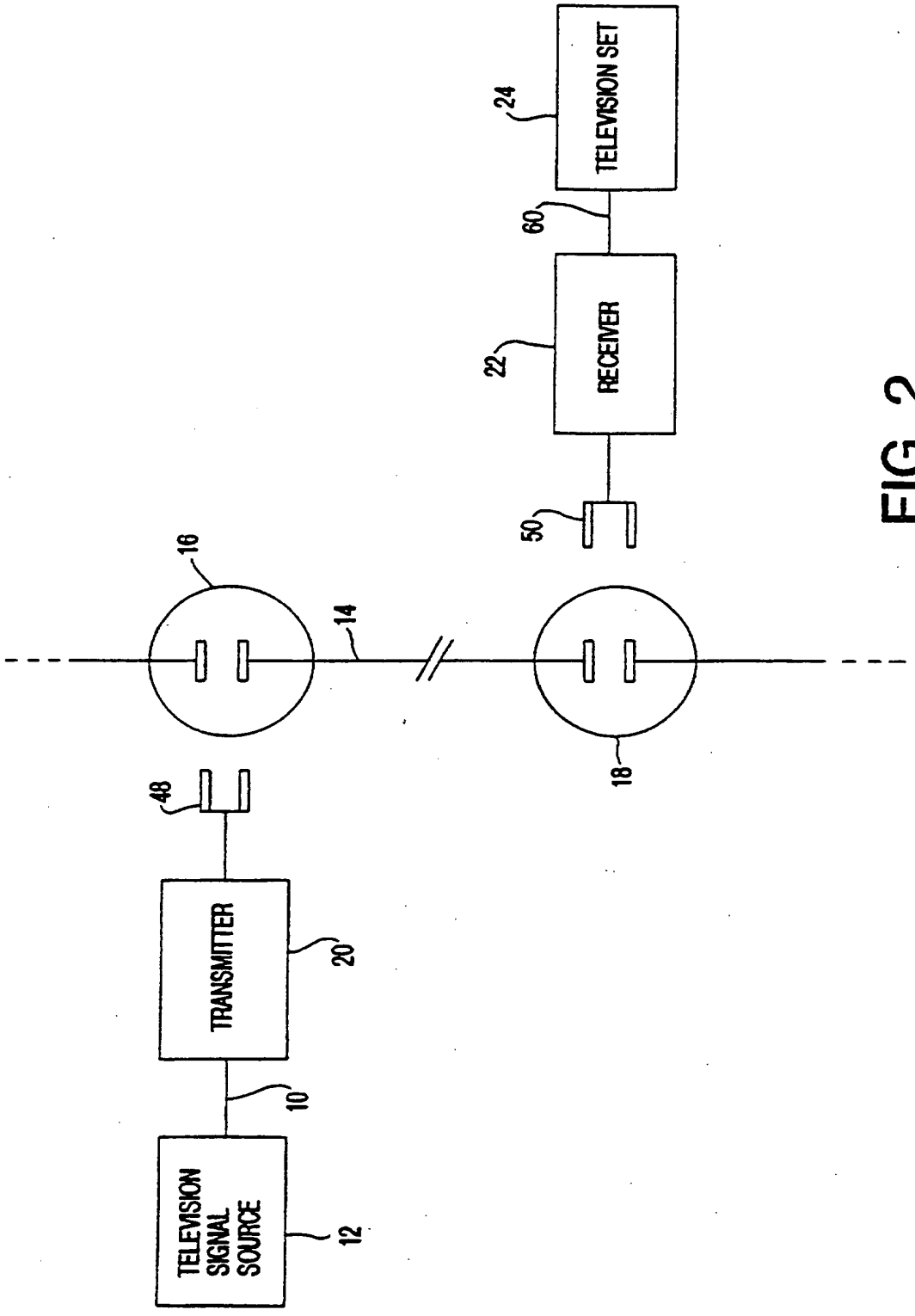
TELEVISION SET
24
60
RECEIVER
22
50
16
14
18
48
TRANSMITTER
20
10
TELEVISION SIGNAL SOURCE
12

FIG. 2

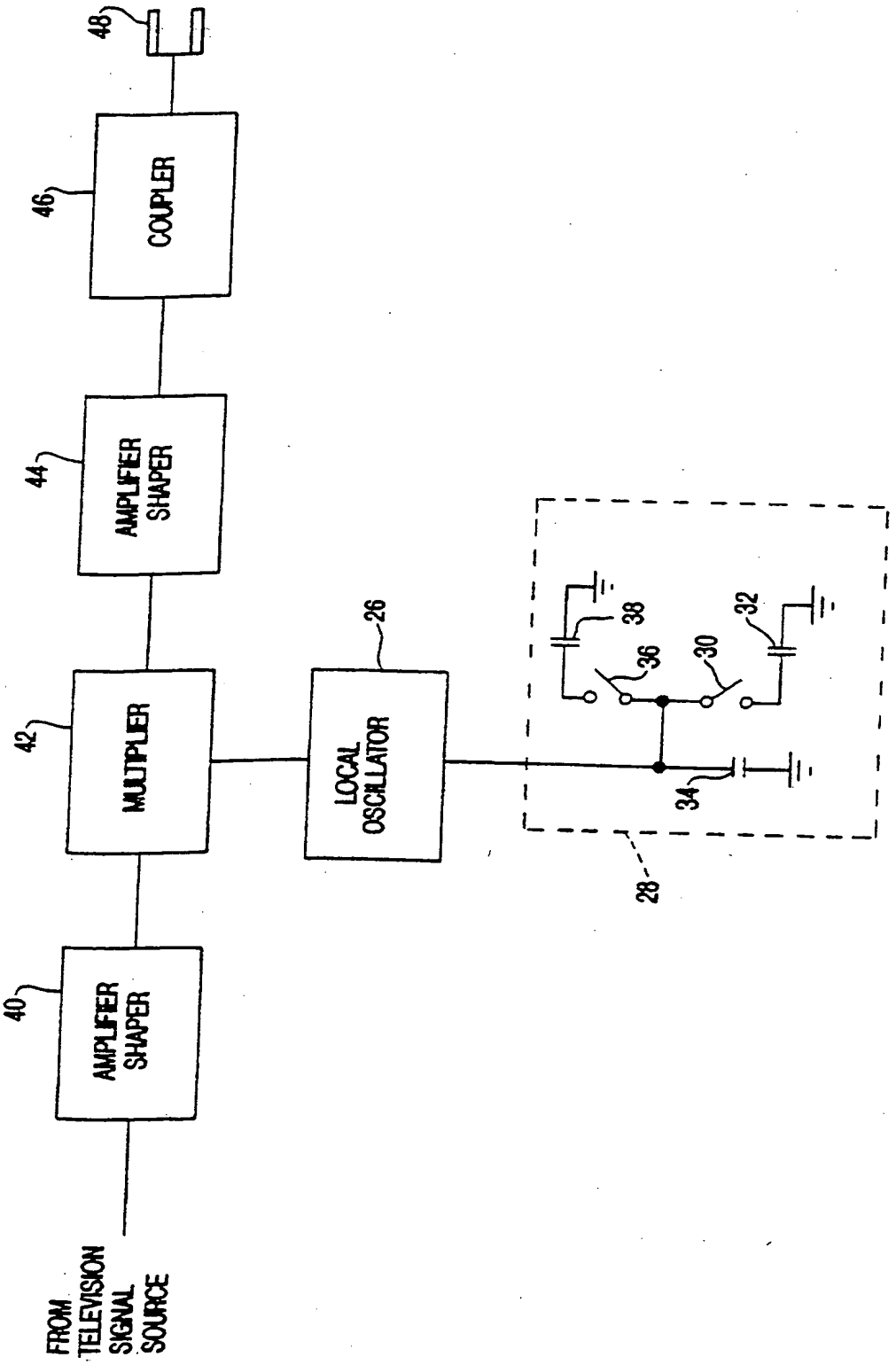

FIG. 3

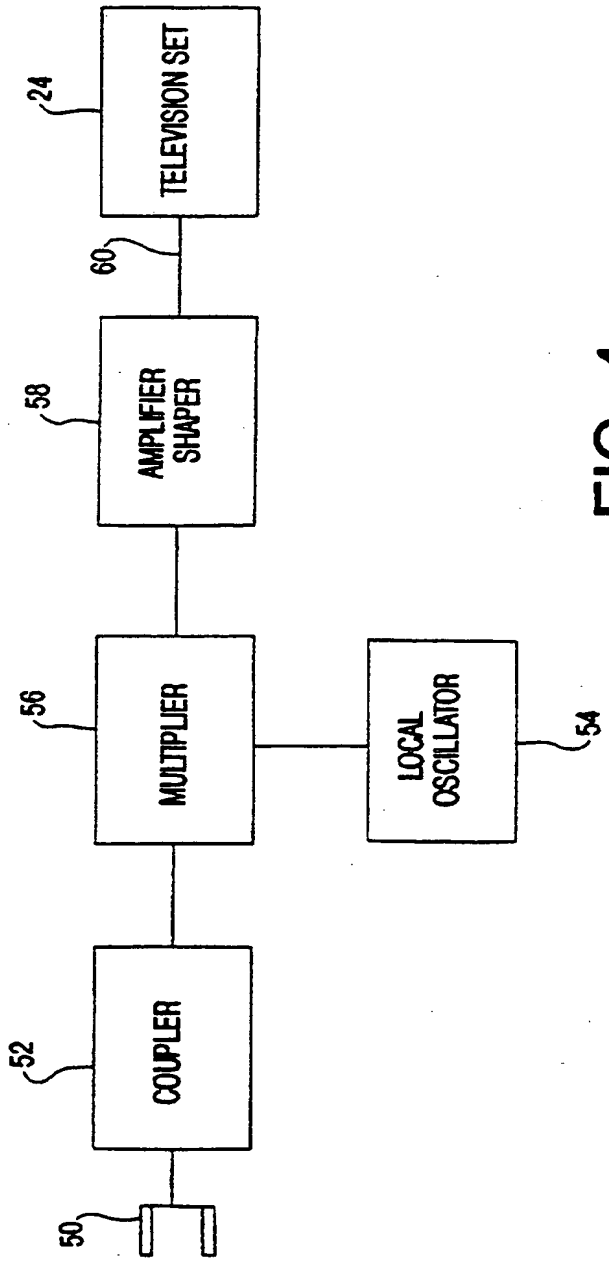
TELEVISION SET
24
60
AMPLIFIER SHAPER
58
MULTIPLIER
56
LOCAL OSCILLATOR
54
COUPLER
52
50

FIG. 4

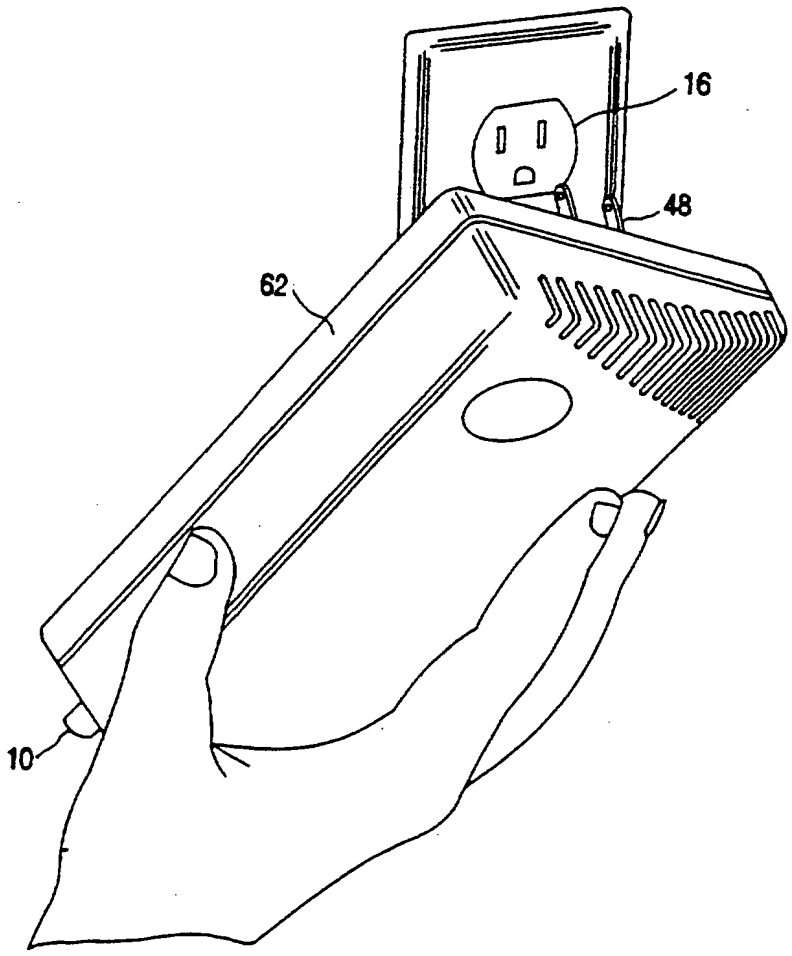

FIG. 5

INTERNATIONAL SEARCH REPORT

Intern al Application No
PCT/US 96/11062

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H04B3/54 H04B3/56

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 H04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 92 21194 A (ECHELON CORP) 26 November 1992 * abstract * see page 1, line 23 - page 2, line 7 see page 3, line 1 - page 4, line 6 see page 5, line 3 - line 15 see page 6, line 25 - page 7, line 4 see page 11, line 22 - page 12, line 2 see claims 1,2,7,11 see figures 1,3 --- -/--	1-4, 7-10, 13-15

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

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"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
7 February 1997	- 5. 03. 97

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax (+31-70) 340-3016	Lopez Marquez, T

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INTERNATIONAL SEARCH REPORT

Inter ial Application No
PCT/US 96/11062

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4 847 903 A (SCHOTZ LARRY) 11 July 1989 * abstract * see column 1, line 28 - line 39 see column 1, line 55 - column 2, line 2 see column 2, line 18 - line 31 see column 2, line 46 - column 3, line 37 see column 4, line 23 - line 41 see column 6, line 35 - column 7, line 2 see column 9, line 7 - line 23 see claims 1,8,9 see figures 1,2 -----	1,7,13

1

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INTERNATIONAL SEARCH REPORT

.ormation on patent family members

Inter ıal Application No
PCT/US 96/11062

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
WO-A-9221194	26-11-92	AU-A-	1918892	30-12-92
		US-A-	5404127	04-04-95
US-A-4847903	11-07-89	US-A-	4829570	09-05-89
		AU-B-	608629	11-04-91
		AU-A-	1945688	21-12-88
		EP-A-	0317610	31-05-89
		GB-A,B	2211704	05-07-89
		HK-A-	34192	15-05-92
		JP-T-	1503831	21-12-89
		WO-A-	8809589	01-12-88
		US-A-	4980665	25-12-90